EXTENSION NOTE

forest sciences
NELSON FOREST REGION

October 2001 EN-057

Partial Cutting Prescriptions in Constrained Areas: Implementing the Guidelines

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■ **Flexibility and ingenuity are required by the logger and the prescribing forester when operating in constrained areas.**

INTRODUCTION

The mandate of forest management legislation and policy has changed over the last decade, reflecting a shift in the values that British Columbians demand from their forests. A higher value has been placed on the visual quality of the forests, and on the conservation of biodiversity. In recognition of changing social expectations, government convened a consultative land use process that resulted in the drafting of land use plans for the Kootenay region in 1995. Refinement of the land use plans into a management framework culminated in the Kootenay/Boundary Land Use Plan Implementation Strategy (KBLUP-IS) in 1997 (Kootenay Inter-Agency Management Committee 1997), and the Kootenay–Boundary Higher Level Plan Order (HLP) in December 2000 (B.C. Ministry of Forests 2000).

These documents, along with other recent legislation and policy, form a legal framework and guidelines for the management of scenic areas and wildlife habitat. Scenic areas identified in the KBLUP-IS have since been designated "known scenic areas" in the HLP under the authority of the *Forest Practices Code of British Columbia Act* (Province of British Columbia 1995), and have had visual quality classes recommended. These changes have confirmed that there will be harvesting constraints along many scenic routes and around communities. In addition, planning for the management and conservation of key species has constrained harvesting at both the landscape and stand levels in the designated ranges of certain species. Often, the resource objectives for an area overlap.

Harvesting in constrained areas requires that foresters fully comprehend policy objectives, and how stand and structural attributes will meet individual or multiple objectives. Multiple and sometimes conflicting objectives must be synthesized into a coherent prescription that often requires highly skilled logging techniques to carry out.

This extension note documents the silviculture prescription (SP) development, harvesting phase, and post-harvest attributes of two partially cut stands in the Kootenay Lake Forest District (KLFD). It also discusses the feasibility of synthesizing multiple resource objectives at the stand level. Both silviculture prescriptions were developed during 1997, simultaneous to the publication of the KBLUP-IS. This policy contains the guidelines applied in this SP for three management objectives: visuals, caribou habitat, and grizzly habitat. Some of these guidelines evolved into law under the HLP in 2000.

HOPE CREEK

Site Description

The Hope Creek block is located midslope above the Lardeau River between 700 and 950 m, on a west-facing, mesic to submesic, 35–70% slope. The site occupies 18.9 ha in the Columbia–Shuswap Moist Warm Interior Cedar–Hemlock (ICHmw2) biogeoclimatic subzone variant (Braumandl and Curran 1992). Soils are predominantly loam and silt loam overlying glaciofluvial parent material. The soil has a high coarse fragment content, and most of the block is shallow to bedrock (40 cm below surface). The stand was composed of mature (100–120 years old) Douglas-fir (Fd), western larch (Lw), western redcedar (Cw), western hemlock (Hw), and birch (Ep). The average tree height in the stand was 35 m, the average diameter was 35 cm, and the basal area was

52 m^2/ha. This site has high hazard ratings for soil compaction, soil surface erosion, and forest floor displacement, and a medium windthrow hazard. This block is adjacent to another partially cut block (strip shelterwood), and borders Goat Range Provincial Park.

Prescription Development

The Hope Creek block is in a known scenic area. A Visual Landscape Inventory completed by the KLFD recommended a Visual Quality Class (VQC) of Partial Retention.[1] This block is visible from the Trout Lake Highway, an unpaved road used by tourists and recreationalists accessing Goat Range Provincial Park and viewing the natural spawning beds at Gerrard.

The Hope Creek block is within a caribou habitat management area. Landscape-level caribou management objectives require 40% of the operable land base to be retained in old seral patches.[2] Outside of old seral patches, including in this stand, stand-level desirable caribou habitat attribute guidelines apply. The silvicultural strategy suggested to achieve many of the attributes is to restrict volume removal to a maximum of 30% of the stand volume. This area is also classified as Grizzly Priority 2.[3] The primary management goals described in the KBLUP-IS are management in areas adjacent to avalanche tracks, access development, and stand-level management of habitat attributes. Hope Creek is located within natural disturbance type 2 (NDT2), an ecosystem with infrequent stand-initiating events (B.C. Ministry of Forests and BC Environment 1995a). In general, the combination of visual objectives, and species-specific wildlife management objectives for this stand call for:

- a harvesting method and extraction level that is visually subordinate in the landscape;
- maintenance of stand attributes for caribou habitat, such as high lichen-bearing trees (large diameter Fd in this stand), low evergreen shrubs, snags, natural levels of coarse woody debris, a windfirm stand, and stand-level connectivity;
- multiple entries to generate release of food and cover species for grizzly habitat; and
- even-aged stand management to mimic NDT2 natural conditions.

The silviculture prescription specified cable harvesting and a combination of two cutting systems to address multiple resource objectives associated with this area: Standards Unit A (SU A) is a preparatory shelterwood[4] (12.5 ha) and SU B (6.4 ha) is composed of patch cuts with reserves.

In SU A, the cutting specifications for this entry called for thinning from below, with stems removed from all but the larger diameter classes (Table 1). Leave trees were to be healthy, with good form, vigour, and colour. Leave trees were marked before harvest. Leaving the larger stems (>57.5 cm), and retaining some unmerchantable Cw were prescribed to enhance the biodiversity of the stand.

Table 1. Cutting rules

dbh class	Rule	No. of leave stems/ha
0–10 cm	Leave all unmerchantable	240
15–20 cm	Take all (conifers)	0
25–40 cm	Take two, leave one (conifers)	68
45–60 cm	Take one, leave one (conifers)	98
65 cm+	Leave all	8
Deciduous	Leave all	91
TOTAL unmerchantable + merchantable		505

Table 1 represents general rules used to mark the trees. It presents results from the pre-harvest cruise where each tree in a cruise plot was assigned a good, fair, or poor rating based on different criteria such as: live crown %, crown shape, health, colour, and height-to-diameter ratio.

The goal of the preparatory cut was to leave an even-aged stand of Fd, Lw, Pw (western white pine), and Cw. This was to be achieved by leaving approximately 250 stems/ha (>12.5 cm dbh) with a residual basal area (RBA) between 16 and 32 m^2, with a median target of 24 m^2 (40–55% of original stand) (Figure 1). Although this level of extraction exceeds the maximum level recommended in the guidelines (30%) to ensure the maintenance of attributes for caribou habitat, this prescription extended the range of harvesting scenarios locally, and tested the economic feasibility of a heavy retention silvicultural system. The goal of the SP was to maintain caribou habitat features within

1 Partial Retention objectives indicate that harvesting activities may be visible but should remain subordinate in the landscape. Since the development of this SP, the VQC recommendation for this area changed to Modification, where activities are visually dominant but have characteristics that appear natural (B.C. Ministry of Forests 2001).

2 Age class 8 or older, and one-quarter of the 40% retained in age class 9 (B.C. Ministry of Forests 2000). Recruitment of younger stands is necessary in landscape units where these targets are not attained.

3 The priority areas were derived from habitat suitability indexes. Four factors are the most influential components of indexes: (1) the relative proportion of avalanche tracks; (2) the quality of the tracks (e.g., forb and berry production); (3) connectivity to alpine areas; and (4) present road/access density. Priority areas (1, 2, and 3) are relative. Priority 1 areas include the relatively better habitats; they are considered the areas with the relatively higher densities of bears.

4 Preparatory cuts improve the vigour and windfirmness of the stand. Generally, a fully stocked stand remains after the cut (B.C. Ministry of Forests and BC Environment 1995b).

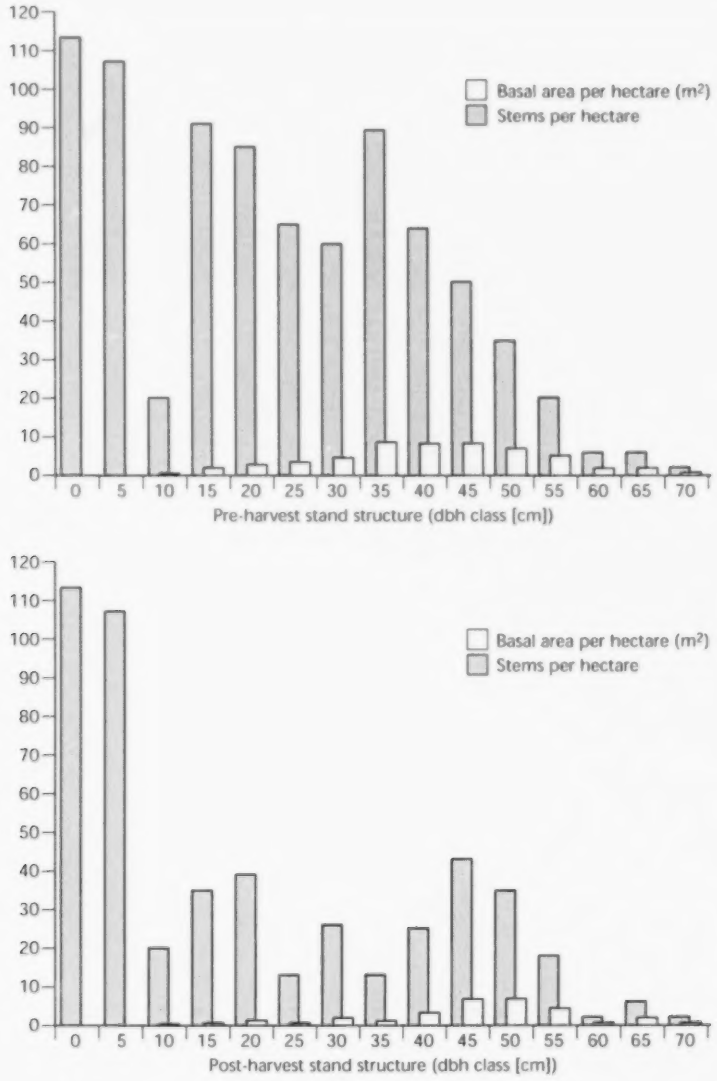
Basal area per hectare (m²)
Stems per hectare
Pre-harvest stand structure (dbh class [cm])
Basal area per hectare (m²)
Stems per hectare
Post-harvest stand structure (dbh class [cm])

Figure 1. Hope Creek stand structure, pre- and post-harvest.

the context of a slightly higher removal level. The range in RBA was prescribed to reflect the within-block variability that was required to maintain windfirmness in the stand (e.g., to retain more trees near the block boundary). A second entry (establishment cut) is planned for 10–15 years to remove the more mature trees, reducing the stand to 15 m^2 of basal area.[5]

The two patch cuts (0.4 and 0.6 ha) in SU B are at the bottom of the shelterwood cut on a gentler slope. Two wildlife reserves are also located here: a permanent reserve occupies 0.8 ha of forested (Fd and Cw) rock cliffs, and a temporary reserve covering 4.6 ha represents the forest type found throughout this stratum of the block. The goal for the temporary reserve is an even-aged stand composed of Fd, Pw, Lw, Cw, and Ep, of 350–400 m^3/ha at the next cutting cycle. The entire temporary reserve will be harvested in approximately 25 years, retaining 25–30 large diameter Fd and Lw stems.

5 Establishment cuts create space for regeneration while maintaining shelter for seedlings (B.C. Ministry of Forests and BC Environment 1995b).

Figure 2. Koller 300 setup at Hope Creek.

Harvesting Operation

The Hope Creek block was cable harvested using a Koller 300 skyline yarder with a Koller SKA-1 carriage, a setup often used for commercial thinning (Figures 2 and 3). A three-man crew consisted of a faller/chokerman, cable yarder operator, and skidder operator. Forty-one person-days of yarding produced 66 m^3/day, and 37 person-days of falling produced 73 m^3/day or two loads per day. Total production was 2715 m^3, 85% of which was sawlog. The area was harvested between June and September 1998. A 518 Cat line skidder was used to forward logs along the road to roadside decks. Having little room to manoeuvre, and a steep side hill below the road, made decking problematic. The chokerman facilitated decking by sorting in the bush so that individual species were yarded in runs.

The maximum yarding distance was 285 m, with an average distance of 250 m. A total of 13 yarding corridors were used, eight of which required an intermediate support.

In three minor cases the logging crew was unable to adhere to the original SP and logging plan. First, all birch (Ep) was to remain in the patch cuts, but in the steeper patch, felling of Ep was necessary to fall surrounding trees. In another case, to accommodate a setting at the switchback in the road, one yarding corridor was placed across the hill diagonally. Over a short distance at the top of the corridor, the minimum corridor width was exceeded. In both cases the original SP and logging plan had not predicted these terrain intricacies. In the third case, the SP was amended to permit some limbing and topping in the bush to minimize damage to leave trees, and for safety reasons.

Figure 3. Yarding at Hope Creek.

Figure 4. View of Hope Creek block from Trout Lake Highway.

Post-harvest Stand Attributes

In general, the harvesting in the Hope Creek stand achieved the objectives set out in the SP. With regard to the recommended VQC of Partial Retention, the harvesting activity in this stand is barely visible, and satisfies the prescription to remain subordinate in the landscape (Figure 4). The patch cuts created two small openings, minimizing the effect of harvesting on visuals and wildlife, and enabling treatment of the debris loading from the slashing of unmerchantable Cw. The temporary reserve will serve as a visual screen and wildlife habitat until the cut portion of the stand achieves visual green-up (forest cover must be of sufficient height to block stumps, logging debris, and bare ground). Yarding corridors to a maximum width of 4 m limited the visual impact. Voids created by harvesting were restricted to one tree-length.

During a post-harvest reconnaissance, the residual basal area was estimated to be 27 m^2/ha, within the target of 16–32 m^2/ha. There were 230 stems/ha, slightly below the original SP target of 250 stems/ha. Although the targeted stocking level was not met, the basal area objective was met. More Ep was removed than planned in the steeper patch cut; this may have contributed to the lower stocking level. More slash was produced than planned due to some limbing and topping in the bush.

Caribou habitat is maintained by retaining large diameter, prime lichen-bearing conifers, vets, and snags; minimizing slash loading by whole tree cable harvesting and the treatment (burning) of slash in the openings; and minimizing disturbance to maintain low evergreen shrubs desirable for forage. Rub trees along the corridors minimized damage to residuals during harvesting. The disturbance that was created along yarding corridors benefits grizzly habitat by generating light and disturbance for the release of forage and cover species. The next planned entry in 15 years will remove mature trees and reduce the basal area to 15 m^2/ha. It should continue to maintain a balance in some of the desirable stand qualities for caribou, grizzly, and the recommended VQC.

LOKI CREEK

Site Description

The Loki Creek block is located in a midslope position above Kootenay Lake on a west-facing, submesic site, with an average slope of 45%. The site occupies 23.8 ha in the Dry Warm Interior Cedar–Hemlock subzone (ICHdw). The soil is a sandy loam. The stand was composed of 90- to 100-year-old Fd, Lw, Py (ponderosa pine), Cw, and Ep, with >250-year-old vets. The average tree height in the stand was 27 m, and the average diameter was 35 cm. The basal area (BA) was 44 m^2/ha. This site has a high hazard rating for soil displacement, surface soil erosion, and forest floor displacement, with a portion of the block having a very high forest floor displacement hazard. The windthrow hazard class is moderate.

Prescription Development

The Loki Creek block is in a known scenic area. The KLFD completed a Visual Landscape Inventory, and established a VQC of Retention.[6] This block is viewed from the middle of Kokanee Lake, and from Amunsden Road and Mirror

6 Retention objectives state that harvesting activities must not be visually evident (B.C. Ministry of Forests 2001).

Lake, two residential areas on the west side of Kokanee Lake.

The Loki Creek block is in a Grizzly Priority 3[7] area. At this time management considerations must be provided only in priority 1 and 2 areas in KLFD.[8] The Loki Creek block is within ungulate winter range; stand-level attributes are provided in the KBLUP-IS. In general, the combination of visual objectives and species-specific wildlife management objectives for this stand require that:

- harvesting activities must not be visually evident; and
- partial cutting must retain 30% mature forest cover for thermal cover, snow interception, and connectivity, to provide ungulate winter range.

The silviculture prescription for Loki Creek specified cable harvesting to remove approximately 70% of the basal area in an establishment cut. All conifers in layer 2 (poles 7.5–12.5 cm dbh), layer 3 (saplings >1.3 m in height, <7.5 cm dbh), and layer 4 (<1.3 m in height) were retained where operationally feasible except for removing or slashing Cw and Hw not located in gullies (Figure 5). Leave trees were marked in blue paint except for Py, all of which was retained, and Ep leave trees >20 cm dbh, which were concentrated along the lower side of the road at a density of 10 stems/ha to act as a visual screen. All marked

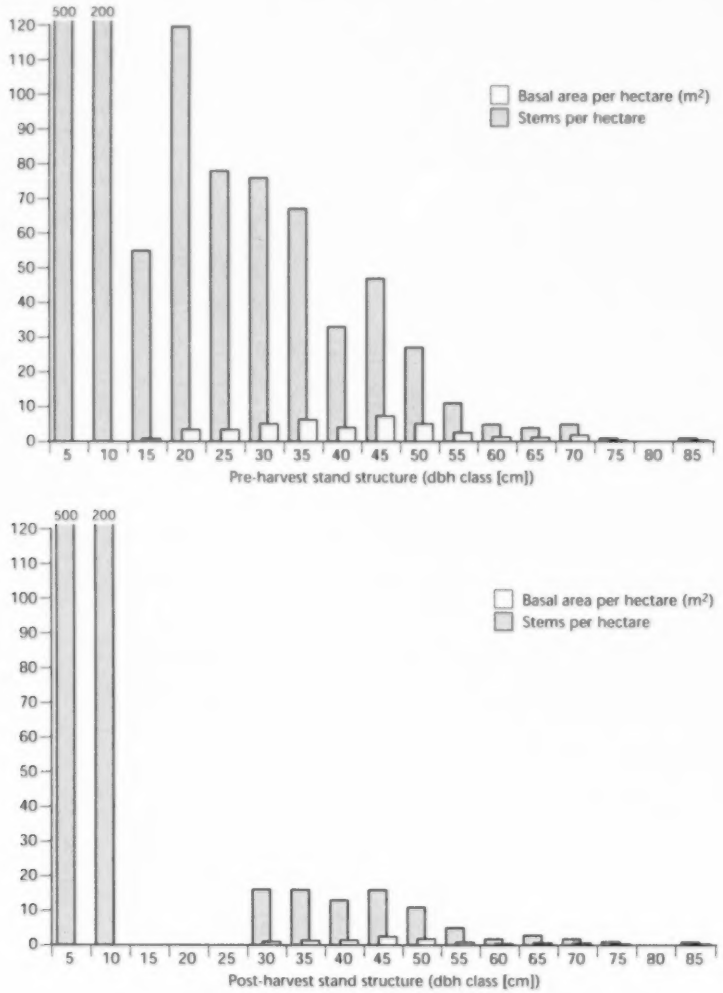

Figure 5. Loki Creek stand structure, pre- and post-harvest.

7 The lowest classification regarding the density of grizzly bears using the habitat.

8 Mike Knapik, Forest Ecosystems Specialist, KLFD, pers. comm.

leave trees were healthy and undamaged with conical crowns >45% and a height-to-diameter ratio of <0.90.

Harvesting Operation

Harvesting began in December 1997–January 1998, and resumed after break-up in May–August 1998. Most of the Loki Creek block was harvested using a Washington 78-A swing yarder. A Komatsu PC200 excavator was used to build approximately 300 m of forwarding trail. Also on site were an International S10 skidder and a 6630 loader. The crew consisted of one faller, two chokermen, one bucker, one yarder operator, and one loader operator. Production was approximately 100 m^3/day; the total production of 5682.2 m^3 consisted of 93% sawlog.

Inter-corridor distance was 50–60 m. Although initially a 4-m maximum was prescribed for yarding corridor width, most corridors ended up being approximately 6 m wide. This was due to the side pull on the carriage caused by yarding trees from the centre points between corridors.

Post-harvest Stand Attributes

In general, the harvesting in the Loki Creek block achieved the objectives set out in the SP. Recommended visual objectives were met (Figure 6). However, rub trees were not designated along yarding corridors, and some damage occurred to leave trees. Damaged trees were retained for visuals. Voids created by harvesting were limited to less than one tree-length. Yarding corridors were wider than planned, due to the harvesting setup. The forwarding trail was rehabilitated after harvesting.

The remaining 75–85 stems/ha (11 m^2/ha BA) of dominant and co-dominant Py, Fd, Lw, and Ep created a uniform shelterwood system. Vets and advanced regeneration for snow interception and thermal cover maintained the habitat for ungulates. Opening up the stand and slashing deciduous shrubs enhanced foraging for both ungulates and grizzly. The next cutting cycle, anticipated in 20–30 years when the regenerating stand creates visual green-up and adequate cover for ungulates, will remove the remaining mature trees, retaining 15–20 stems/ha. The remaining stems, advanced regeneration, and expected natural regeneration will give the structure to maintain ungulate winter range and accommodate recommended visual objectives.

SUMMARY

The Hope Creek prescription successfully addressed the multiple management objectives in that landscape. The prescription extended the tested range of harvesting scenarios locally. It demonstrated that a heavy retention silvicultural system was economically feasible, while retaining or enhancing caribou and grizzly habitat attributes. Tourists travelling on the Trout Lake Highway to Goat Range Provincial Park and the spawning beds at Gerrard may be unaware of the light harvesting activity in the Hope Creek block.

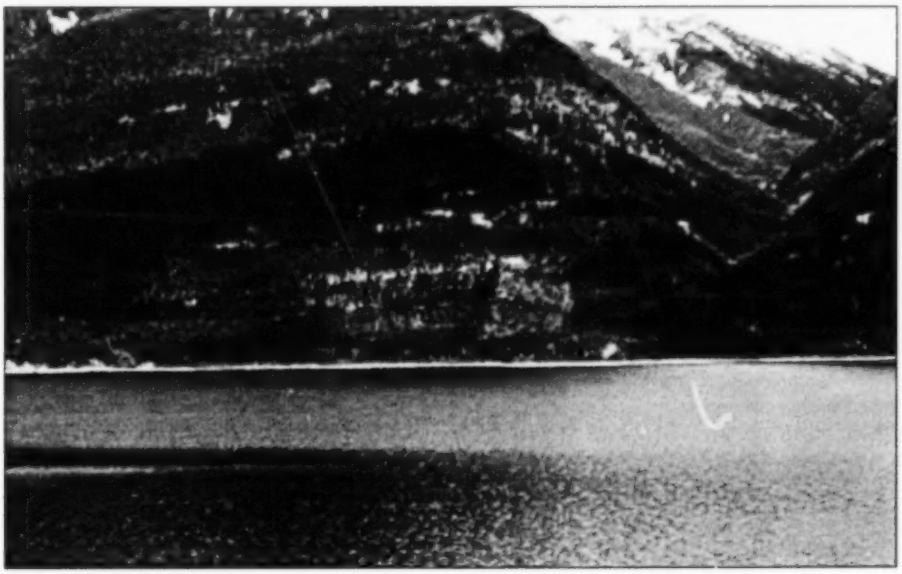

Figure 6. View of Loki Creek block from the west side of Kootenay Lake, at Amunsden Road.

Flexibility and ingenuity were required from the logger and the prescribing forester during harvesting. This SP was difficult to carry out, and effective communication and supervision were critical to successful harvesting. Where the SP was operationally not feasible to implement, minor amendments were required.

The forested lower slopes of Mount Loki are a mosaic of natural openings, rock outcrops, and mixed forest. The partial cut harvested from the lower slopes retained a stand that blends into the landscape, and maintains the aesthetic and wildlife values of this forest.

The success of these SPs must also be considered in the context of the surrounding landscape. Ungulate, grizzly, and caribou habitat management require that a diversity of seral stages be planned at the landscape level to achieve connectivity and habitat requirements. These two blocks demonstrate that it is operationally feasible to meet a variety of objectives by partial cutting in the ICHmw2 and ICHdw. Specific management objectives can be met at the stand level through carefully designed layout, appropriate removal levels, and the protection of desirable structural attributes.

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ACKNOWLEDGEMENTS

The authors appreciate the support and review comments provided by Genevieve Lachance (Arrow Forest District) and review comments by Mike Geisler and Mike Curran (Nelson Forest Region) and Mike Knapik and Jim Annunziello (Kootenay Lake Forest District).

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